

Appendix G : Case Studies

Case Study 1 – Manufactured Home

Case Study 2 – Single Family Home

Case Study 1 – Manufactured Home

Unit Type: Single-Wide Manufactured Home
Client Address: Wilmington, New Hanover County, NC



Introduction to the Case Study

A young couple with one child who own and reside in the home filed an application for the Weatherization Assistance Program (WAP). After the application was approved, a Weatherization Inspector visiting the home in February 2000 performed a series of inspections which focused on opportunities for both weatherization and hazard mitigation. This Case Study documents the inspections, the identification of opportunities for improvement and final recommendations. It illustrates the integration of the weatherization and hazard mitigation inspections and the decision making process used by an Inspector after receiving Hazard Identification & Mitigation (HI&M) training.

Description of the Home

The client lives in a 1966 single-wide manufactured home consisting of a living room/kitchen combination, two bedrooms and one bath. It is located in a dedicated mobile home park with water, sewer and electrical underground utility hook-ups. A paved road provides access to the home and the park includes trees and vegetation. There is a system of drainage ditches to channel stormwater away from the homes.



Identification of Weatherization Opportunities

On arriving at the home, the Inspector introduced himself to the clients and made sure they were aware of the purpose and goals of the WAP. Then he performed a simple review of the exterior and interior of the structure as a whole to ensure that the home conformed to program guidelines. The review included sketches and measurement of the home's layout. The unit was found to be structurally sound, so investment of funds to make the home more energy efficient was justified.

The Inspector then used a standard blower door test to evaluate the "air tightness" of the home. The test is designed to indicate if the home has air leaks that allow heat to escape and make the home less energy efficient. The home scored as follows:

Current Blower Door Reading:	2,800 cfm
Desired Blower Door:	1,500 cfm

The blower door test results indicated the home had considerable air leakage. Leakage was found around the front door frame, where the original door had been replaced and around the second door that was improperly sized in a poorly fitted frame.

Broken and missing windows in the home also made a significant contribution to the poor blower door readings.



The Inspector then examined the furnace and interior heating systems. The furnace was located in a central cupboard, was improperly installed and not in working condition. There was considerable air leakage around the unit, as well as leakage through an unsealed flue from the original furnace. The heating ductwork was also in extremely poor condition. Many of the vents were rusted through, and the clients had taped cardboard over them to try to reduce the cold airflow. It was determined that these ducts could not be used.

After completing the blower door test and furnace inspection, the Inspector decided that there were opportunities to use WAP funds to improve the energy efficiency of the home. Weatherization measures to stop air infiltration included the installation of doors and windows, and applying caulking, roof cement and



mobile home coating.

The Inspector then estimated the types and quantities of materials required to complete the Weatherization improvements to the home.

Weatherization Materials Listing:

- 1 Diamond Door
- 2 2x4x8 Treated Lumber
- 1 3/4" Plywood
- 12 Mobile Home Windows
- 15 Caulking Tubes
- 1 Gallon of Roof Cement
- 48" Door Casing
- 1 Pound of #6 Finishing Nails
- 2 5-Gallon Containers of Mobile Home Coating
- 8 Putty Tape Rolls
- 13 Boxes of Screws

Estimated Material Cost: \$761

Estimated Labor Cost: \$761 (1:1 materials to labor multiplier)



Heating Appliance Repair and Replacement Program (HARRP)

Measures:

The client currently uses electric space heaters as their only heat source because the furnace is inoperable. The inefficiency of the space heaters, combined with the high air leakage, have led to extremely high monthly utility bills. Therefore, the Inspector recommended that the client receive a gas monitor space heater that will provide adequate, safe heating for the family.

Projected Cost: \$1,500.00 (Current CO Reading: 0 ppm)

Hazard Identification and Mitigation Measures:

Before going to inspect the home, the Weatherization Inspector determined the relative risk of flood, fire, wind and earthquake for the home. The Inspector found that the region of New Hanover County, NC is at some risk from all four hazards.



Flood - The Flood Insurance Rate Map showed that the home is in an unshaded Zone C, an area outside the 500 year floodplain. The Inspector noted that because the home dated from 1966, before current FEMA standards were established, the consequences of flooding might be severe. He also noted that the area is susceptible to localized flooding from hurricanes. The FIRM suggested a low risk of flooding from riverine or coastal flooding, and the Inspector decided to check the localized chance of flooding during the inspection.



Wind – The Wind Zones in the US map clearly shows New Hanover County to be in the orange, Zone III region. It also showed the Inspector that the area is subject to hurricanes. The Inspector decided that this hazard posed a major threat and assessed the risk at medium high.



Earthquake – The National Map of Earthquake Zones suggests that New Hanover County is in a moderate risk area. Deciding to investigate this further, the Inspector reviewed the more detailed map of North Carolina. It showed that the most of New Hanover County was in the blue or low medium risk area.



Fire – The Inspector then consulted the Map of Fire Risk. By examining the fire risk on a monthly basis, the Inspector determined that New Hanover County has a fire score of 7 which makes it at moderate risk for fire.

In summary, before the Inspector had even visited the site, the relative risks from these four natural hazards had been assessed and prioritized as wind, fire, earthquake and flood. During training, the Inspector had also been informed of additional programs and resources to maximize the benefits to the client.

As the Inspector approached the property to perform his initial assessment for conformity to weatherization program guidelines, he noticed the grading around the home. The land is flat and may be susceptible to flooding from heavy hurricane rainfall. The Inspector observed a large stormwater ditch behind the home that was generally clear of obstructions, so he was satisfied that the home had a low risk of flooding. Also, as in most manufactured homes, the base of the unit was installed two feet above ground level.

After introducing himself to the clients, the Inspector performed an exterior evaluation of the home. The inspection included drawing a plan of the structure and identifying window sizes and styles. This time was the perfect opportunity to review the exterior of the home for hazard mitigation





opportunities. The review focused on the higher risk wind hazard and included checking whether the mobile home was properly strapped and anchored. The home had standard “over the top” style straps, but a number of them were not adequately secured and were loose when pulled by hand.

The Inspector looked under the home to inspect the anchoring of the straps to the frame of the home and to the ground. The anchoring was adequate and used standard ground anchors that were appropriate for the conditions expected.

The exterior surface sheathing of the home was noted as being in fair condition. The doors and windows were noted as poor from a hazard mitigation perspective but would probably be replaced as part of the WAP. Most of the property was free and clear of debris. During the weatherization process excess building materials and debris would be removed from the property, in order to further reduce the potential for windborne debris.

When the Inspector moved to the interior of the home and performed the standard blower door test, he walked through the mobile home looking for air leaks. During this process he also assessed the interior of the home for potential hazards. Although earthquake was a low medium risk, he noted that the interior did not include many overhead cupboards, free standing furniture or other heavy elements that could break free or topple during an earthquake.

The Inspector did notice, however, that there were no operating smoke or carbon monoxide detectors in the home. Although the risk of fire outside the home was reduced by a noticeable gap or fire break between homes and a lack of debris, the interior was at risk. The Inspector made a note to install smoke and carbon monoxide alarms, hard-wired with battery back-up.





While performing a review of the furnace and interior heating systems, the Inspector observed the poor furnace installation. As part of the HARRP program the Inspector recommended installing a gas-fueled heating system that would include gas tanks outside the home. Although this potential hazard was not present at the inspection, the Inspector saw a potential for leveraging his funds from HARRP, WAP and HI&M. The Inspector recommended that while the certified gas installer was putting the heating system in place that he also install

a gas safety cut-off valve on the fuel line. The cut-off valve would reduce the risk of gas leakage if there were a break from wind, flood or earthquake. In addition, the gas tanks themselves should be elevated and strapped.

After concluding the inspection, the Inspector estimated the types and quantities of materials required to complete the Hazard Mitigation improvements to the home.

Hazard Mitigation Materials Listing:

- 2 Smoke & Carbon Monoxide alarms
- 1 Gas Safety Cut-Off Valve
- 4 2x4x8 Treated Lumber – for raising the gas tanks & interior furnace
- 2 1x4x10 Treated Lumber – for bracing the gas tanks & interior furnace
- 1 ¾” Plywood– for raising the gas tanks & interior furnace
- 1 Reattachment of Anchoring Straps

Estimated Material Cost: \$300

Estimated Labor Cost: \$300 (1:1 materials to labor multiplier)



The Inspector successfully integrated the WAP and HI&M inspections and recommendations. He used HI&M training to evaluate the relative risks of the hazards and match them against conditions at the property. The Inspector made recommendations of mitigation measures to directly reduce the particular risks at the home and combine program resources to maximize the benefits for the client.

Case Study 2 – Single Family Home

Unit Type: Single Family, Wood-Frame Home

Client Address: Wilmington, New Hanover County, NC



Introduction to the Case Study

An elderly homeowner filed an application for the Weatherization Assistance Program (WAP). After it was approved, a Weatherization Inspector visiting the home in February 2000 performed a series of inspections which focused on opportunities for both weatherization and hazard mitigation. This Case Study documents the inspections, the identification of opportunities for improvement and final recommendations. In particular, the Study illustrates the integration of the weatherization and hazard mitigation inspections and the decision-making process an Inspector uses after receiving Hazard Identification & Mitigation (HI&M) training.

Description of the Home

The client's home is a small, wood-frame unit consisting of four rooms and one bathroom. Four people reside in this home including an elderly person and children. The home is located near a main highway and access to is provided along 800 yards of poorly maintained dirt road. There are telephone and electricity hook-ups, but water comes from a well on the property. Sewage goes to a drain field. The area around the home is heavily wooded with light vegetation at grade level adjacent to the home.

Identification of Weatherization Opportunities

On arriving at the home, the Inspector introduced himself to the client and made sure she was aware of the purpose and goals of the WAP. Then he performed a basic review of the exterior and interior of the overall structure to ensure that the home conformed to program guidelines. The review included sketches and measurement of the home's layout. The unit was found to be structurally sound, except for a portion of the roof. Most of the roof sheathing consisted of wood boards running the length of the house and was found to be in fair condition. However, in one corner, the fascia board had rotted and part of the eave was missing, and, in another corner, the eave was badly damaged from rot and weathering. There was no insulation, and the missing eave created a large gap between the roof and wall.



The Inspector noted that this portion of the roof needed replacement. Although replacing the damaged portion of the roof would be more than the WAP alone could fund, weatherization by installing insulation would be useless without it. Also, from a risk mitigation standpoint, the Inspector realized that if the eave was not repaired, winds could blow up and into the roof space during a future hurricane. This action could accelerate the roof damage and potentially destroy the entire home. Therefore, it was in the best interests of the homeowner, WAP, and HI&M to repair the roof.



When the Inspector examined the inside of the home, he found that the door to the plastic-enclosed porch area was permanently open, so the energy efficiency of the home was further reduced. The Inspector decided to install doors on the porch and reduce air infiltration. The Inspector also recommended that attic insulation be installed. To help eliminate air infiltration, he further recommended applying minor glazing, caulking, and roof cement. The Inspector estimated the types and quantities of materials required to make the weatherization improvements to the home.



Weatherization Materials Listing:

- 2 6-Panel Doors
- 2 Peep Holes
- 2 Door Lock Combinations
- 3 Pairs of Hinges
- 2 2-Piece Thresholds
- 2 Weather Strip Sets
- 1 2x6x8 Treated Lumber (For eave)





- 15 Caulking Tubes
- 8 Glazing Tubes
- 1 Gallon of Roof Cement
- 1 Foam Tape Roll
- 1 #8 Nails (Pound)
- 1 Storm Door Closure
- 1 Insulation for 20x26 Attic (use R rating appropriate to local codes)

Estimated Material Cost: \$650

Estimated Labor Cost: \$650 (1:1 materials to labor multiplier)



Heating Appliance Repair and Replacement Program (HARRP) Measures:

When the Inspector examined the furnace and interior heating systems, he found the client used unvented kerosene heaters as the sole heat source. The inefficient heaters were expensive to operate and were a safety hazard. Therefore, the Inspector recommended that the client receive a gas space heater to provide adequate, safe heating for the family.



Projected Cost: \$1,200.00
(Current CO Reading: 92 ppm)



Hazard Identification and Mitigation Measures:

Before going to inspect the home, the Weatherization Inspector determined the relative risks of flood, fire, wind, and earthquake to the home. The Inspector found that the region of New Hanover County, NC is at risk from all four hazards.

Flood - The Flood Insurance Rate Map showed that the home is in an unshaded Zone C, an area outside the 500-year floodplain. The Inspector noted that because the home dated from 1966, before current FEMA standards were established, the consequences of flooding might be severe. He also



noted that the area is susceptible to localized flooding from hurricanes. Therefore, although the FIRM suggested a low risk of flooding from riverine or coastal flooding, the Inspector decided to check the chance of localized flooding while he was doing the inspection.



Wind – The Wind Zones on the U.S. map indicates that New Hanover County lies in the orange, Zone III region. It also shows the Inspector that the area is at risk for hurricanes. Taken together with the fact that there are numerous large trees nearby that could fall on the home, the Inspector decided that this hazard posed a significant threat, and so, assessed the risk at medium high.



Earthquake – The National Map of Earthquake Zones suggests that New Hanover County is in a moderate risk area. Upon further investigation, the Inspector reviewed a more detailed seismic map of North Carolina, and concluded that most of New Hanover County was in the blue or low medium risk area.



Fire – The Inspector then consulted the Map of Fire Risk. After calculating the fire risk on a monthly basis, the Inspector determined that New Hanover County has a fire score of 7 which makes it at moderate risk for fire.

In summary, before the Inspector had even visited the site, he had assessed the relative risks of these four natural hazards and prioritized them in order as wind, fire, earthquake, and flood. During training, the Inspector had also been informed of additional programs and resources to maximize the benefits to the client.

As the Inspector approached the client's property to perform his initial assessment for conformity to Weatherization program guidelines, he also noted the grading around the home and the type of soil. Although the terrain is flat and appears to be susceptible to flooding from heavy hurricane rainfall, the soil is very loose and sandy. Conversations with the homeowner confirmed that the area drained very quickly because of the soil characteristics and there had been no flooding in living memory. Therefore, the Inspector was satisfied that flooding was indeed a lower risk for this home.

As mentioned previously, the Inspector first performed an exterior evaluation of the home. The evaluation included drawing a plan of the structure and identifying the window sizes and styles. At the same time, he examined the exterior of the home for hazard mitigation opportunities. Consistent with his focus on the higher risk wind hazard, the Inspector noted the need for roof repairs.

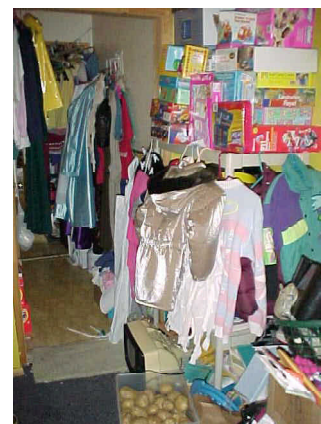
The exterior of the home appeared to be anchored properly to the ground and the side sheathing was in fair condition. The doors and windows were



noted as poor from a wind-risk mitigation perspective but would probably be replaced as part of the WAP. There was little to no debris on the property.

When the Inspector moved to the interior of the home and performed the standard blower door test, he walked through the single family home looking for air leaks. During the test, he also assessed the interior of the home for other potential risks. Although earthquake was a low medium risk, he noted that the interior included many stacked boxes that were at risk of breaking free or toppling during an earthquake.

The Inspector also noted that there were no operating smoke or carbon monoxide detectors in the home. Although the risk of fire outside the home was reduced by a noticeable gap or fire break between homes and a lack of debris, the interior was at risk. The Inspector recommended installing smoke and carbon monoxide detectors, hardwired with a battery back-up.



After examining the furnace and interior heating systems, the Inspector recommended installing a gas-fuelled heating system that would include gas tanks outside the home. Although this potential fire risk was insignificant, the Inspector saw the potential for leveraging his funds from HARRP, WAP, and HI&M. The Inspector recommended that while the certified gas installer was putting the heating system in place that he also install a gas safety cut-off valve on the fuel line. Doing so would reduce the risk of gas leakage if there were an interruption from wind, flood or earthquake. The tanks themselves should be strapped in place at a minimum and also elevated if there are enough funds left.



After concluding the inspection, the Inspector estimated the types and quantities of materials required to complete the Hazard Mitigation improvements to the home.

Hazard Mitigation Materials Listing:

- Replace damaged or missing portion of roof
- Install Smoke and CO Alarms – hardwired with battery back-up
- Install Gas Safety Cut-Off Valve on fuel line
- Elevate and strap gas tanks

Estimated Material Cost: \$900

Estimated Labor Cost: \$900 (1:1 materials to labor multiplier)

The Inspector successfully integrated the WAP and HI&M inspections and recommendations. Without the roof improvements, weatherization would have not been possible. The Inspector made recommendations of mitigation measures to directly reduce the particular risks at this home and combine program resources to maximize the benefits for the client.